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Seasonal variation and site specificity of external parasites in gold fish (*Carassius auratus* L.) and koi carp (*Cyprinus carpio* L.) in Rambadagalle Ornamental Fish Breeding Center, Sri Lanka

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Abstract. Seasonal variation and site specificity of external parasites in gold fish (*Carassius auratus*) and koi carp (*Cyprinus carpio*) cultured at Rambadagalle fish breeding and training center were estimated during wet (February-July) and dry (August-November) seasons in 2013. According to the proportion of the total harvest, samples of 30 gold fish and 50 koi carps in the same cohort were collected from two separated harvesting ponds. Their gills, skin scrape and fins were examined in the laboratory for ectoparasites, and the percentage prevalence of parasites at each site of two fish species during two seasons were calculated and compared statistically. Ten external parasite species (*Trichodina* sp., *Apiosoma* sp., *Tripartiella* sp., *Chilodonella* sp., *Ichthyobodo necator*, *Gyrodactylus* sp., *Dactylogyrus* sp., *Centrocestus* sp., *Posthodiplostomum cuticola*, *Argulus* sp.) were recorded from both fishes during two seasons. *Posthodiplostomum cuticola* and *Chilodonella* sp. were not recorded from koi carp while *Argulus* sp. was not detected from gold fish. Koi carps were highly parasitized during dry season while it was wet season for gold fish. During two seasons, for both fish species, percentage prevalence of *Trichodina* sp. (skin: ranged from 58%-100%, fins: 12%-97%) and *Apiosoma* sp. (skin: ranged from koi 28%-100%, fins: 12%-82%) were high in skin and fins. In contrast, during two seasons, for both fish species high percentage prevalence of *Dactylogyrus* sp. (ranged from 37%-54%) and *Centrocestus* sp. (ranged from 62%-90%) were recorded from gills. For each fish species, total number of parasites infected in skin, fins and gills were significantly different (< 0.05) between two seasons.

Keywords. Gold fish, koi carp, ectoparasites, seasonal variation, site specificity

1 Introduction

Parasitism is one of the most impacting problems in aquaculture industry (Scholz 1999). The diversity of the parasitism is high in wild fishes and limited in cultured fishes whereas intensity of parasitism is high in cultured fishes and low in wild fishes (Scholz 1999). Cultured fish are continuously affected by environmental fluctuations and management practices such as fluctuating temperatures, poor water quality and handling, crowding, transporting etc. Those factors could impose considerable stress on the homeostatic mechanisms of fish, rendering them susceptible to a wide variety of parasites (Thilakarathna *et al*. 2003; Pampoulie *et al.* 2004). Parasitic diseases of fishes are usually encountered more often than microbial and other diseases (Mahmoud *et al*. 2011). From 30 to 50 percent of fish disease cases reported in laboratories are recorded as caused by parasites (Rogers 1978). The effects of parasitism in fish result poor growth/ production and the susceptibility to secondary infections (Scholz 1999). Most parasitic diseases harm the quality of fish which directly affects the marketable price of a fish. Some parasites are able to reproduce rapidly until it comes to pathogenic conditions and contribute to high mortalities and economic loss (Bhuiyan *et al.* 2007). Endoparasites are more harmful than ectoparasites, and cause severe mortalities of fishes in aquaculture industry (Shalaby and Ibrahim 1988).

'Rambadagalle Ornamental Fish Breeding and Training Center' supplies variety of ornamental fish species to Sri Lankan and international markets. However, scientific studies on parasitic infections on fishes culturing at the center are limited but necessary for designing proper treatment programs. Especially, koi carp (*Cyprinus carpio*) (Linnaeus 1758) and gold fish *Carassius auratus* (Linnaeus 1758) that belong to the family Cyprinidae have gained a high demand in local and export markets. Therefore, this study was designed to study the seasonal variation and site specificity of external parasites in gold fish (*Carassius auratus*) and koi carp (*Cyprinus carpio*) during dry and wet seasons at the Rambadagalle fish breeding center.

2 Materials and Methods

Gold fish and Koi carp samples were collected from the harvest of Rambadagalle Ornamental fish breeding and training center during the wet (February-July) and dry (August-November) seasons. Samples were collected according to the ratio of the harvest, thus for each season, samples were

consisted with 30 gold fish and 50 koi carp individuals both of which were in the age group of 45 days. Upon sampling, fishes were stocked in glass tanks filled with the pond water. For examinations of parasites, fish samples were collected randomly.

All selected fishes were examined by naked eye for skin parasites, and if available, they were collected into a bowl containing 4% formalin. Then, a skin scrape was taken along the body horizontally (from base of the operculum to base of the caudal fin) using a cover slip. To keep the consistency throughout the study, skin scrape was taken only once from each individual. The scraping was placed on a slide with a drop of water, and a cover slip was placed on it avoiding gas bubbles. Excess fluid was removed by using a tissue paper. Separate slides were prepared to examine parasites live in gills and the caudal fin of each individual. A gill and a part of a fin were randomly removed using a scissor and forceps, and slides were prepared as mentioned above to examine the parasites properly. Prepared slides were examined under the compound microscope, and total numbers of parasites were calculated accordingly. The parasites were identified according to the reference materials (Das & Das 1997; Scholz 1999; Durborow 2003; Mishra *et al*. 2007).

Prevalence for each parasite species was calculated for three sites (skin, fins and gills) of each fish species during two seasons using the following equation,

$$\text{Prevalence} = \frac{\text{Number of infected fish}}{\text{Total number of fish examined}} \times 100$$

The difference of total abundance of parasites among skin, fins and gills during two seasons for each fish species was statistically compared using non-parametric (Kruskal-Wallis) test. All calculations were performed using MINITAB (V.14) software.

3 Results and Discussion

The observed external parasite species and their prevalence during two seasons at three different sites of the body of koi carp and gold fish are given in the Table 1 and Table 2 repectively. According to the Kruskal -Wallis test, the difference of prevalence of parasites in skin, fins and gills during two seasons for each fish species was statistically significant ($p< 0.05$).

Table 1. Infected parasite species and their prevalence at each site (skin, fin, gills) of koi carp (*Cyprinus carpio*) during two seasons.

Infected Parasites species	Prevalence of parasites during wet season (%)			Prevalence of parasites during dry season (%)		
	Skin	Fins	Gills	Skin	Fins	Gills
Trichodina sp.	58	18	ND	86	12	6
Apiosoma sp.	28	12	ND	100	82	6
Argulus sp.	2	ND	ND	2	ND	ND
Gyrodactylus sp.	16	ND	ND	8	ND	ND
Dactylogyrus sp.	ND	ND	38	ND	ND	54
Centrocestus sp.	ND	ND	62	ND	ND	64
Ichthyobodo necator	ND	ND	4	ND	ND	ND
Tripartiella sp.	ND	ND	ND	ND	ND	18
Chilodonella sp.	ND	ND	ND	ND	ND	ND
Posthodiplostomum cuticola	ND	ND	ND	ND	ND	ND

ND: Not Detected

According to the results, seasonal variation of abundance of parasites could be observed in both fish species. During wet season, koi carp was parasitized by *Trichodina* sp., *Apiosoma* sp., *Argulus* sp., *Gyrodactylus* sp., *Dactylogyrus* sp., *Centrocestus* sp. and *Ichthyobodo necator,* but in dry season in addition to the above mentioned species, *Tripartiella* sp. has been recorded. The highest percentage of prevalence during wet season was shown by *Trichodina* sp. (skin -58%, fins -18% and the gills-0%), while it was *Apiosoma* sp. (skin -100%, fins-82% and the gills -6%) during dry season.

For goldfish, during wet season *Trichodina* sp., *Apiosoma* sp., *Gyrodactylus* sp., *Dactylogyrus* sp., *Centrocestus* sp., *Ichthyobodo necator* and *Posthodiplostomum cuticola* were recorded. In addition to that *Tripartiella* sp. and *Chilodonella* sp. were identified during dry season. *Trichodina* sp. infested all three sites of gold fish during both seasons (Percentage prevalence: wet season - skin-100%, fins-96.67%, gills-86.67%: dry season - skin-70%, fins-43.34%, gills-6.67%).

Table 2. Infected parasites species and their prevalence at each site (skin, fin, gills) of gold fish (*Carassius auratus*) during two seasons.

Infected Parasites	Prevalence of parasites during wet season (%)			Prevalence of parasites during dry season (%)		
	Skin	Fins	Gills	Skin	Fins	Gills
Trichodina sp.	100	96.67	86.67	70	43.34	6.67
Apiosoma sp.	33.34	23.34	ND	40	30	ND
Argulus sp.	ND	ND	ND	ND	ND	ND
Gyrodactylus sp.	ND	6.67	ND	26.67	10	ND
Dactylogyrus sp.	ND	ND	46.67	ND	ND	36.67
Centrocestus sp.	ND	ND	80	ND	ND	90
Ichthyobodo necator	ND	3.34	ND	ND	ND	ND
Tripartiella sp.	ND	ND	ND	ND	ND	13.34
Chilodonella sp.	ND	ND	ND	13.34	6.67	33.34
Posthodiplostomum cuticola	ND	33.34	ND	ND	13.34	ND

ND: Not Detected

The comparison of total number of infected parasites on two fish species indicated that the gold fish is more susceptible for parasitic infections than koi carp during both seasons ($p<0.05$). Fish parasitic infections are greatly influenced by seasonality. The results of the current study were also consistent with the past studies (Pennycuick 1971; Rahman *et al.* 2007), and indicated that seasonal changes in temperature, hardness, suspended solid, Nitrate, Phosphate may have been responsible for the differences in the prevalence of parasite species on both fish species. It could be suggested that due to fluctuation of environmental conditions, fishes become stressed thus parasites get an opportunity to reach host for their survival. Further, swimming pattern of the fishes could be another factor for intensity of parasitic infection of fishes, because gold fishes are slow moving and koi carps are fast moving fishes.

Both environmental and water quality parameters are responsible for the stress conditions of fishes (Nnadi *et al.* 2011).When exposed to unfavorable conditions it caused stress conditions in fishes which act as a supportive factor to increase the parasite abundance (Kadlec *et al.* 2003). Therefore, with the

favorable conditions prevailed during dry season (such as temperature, hardness, suspended solid, Nitrate, Phosphate etc.), abundance of some parasites species (protozoans) may have increased rapidly.

The results indicated that recorded parasite species were site specific, and prevalence of parasites in skin, fins and gills during two seasons for each fish species was statistically significant ($p<0.05$). According to the observations, *Centrocestus* sp., *Dactylogyrus* sp. and *Tripartiella* sp. have been recorded only from the gills, while *Posthodiplostomum cuticola* has been recorded only from the fins of gold fish, and *Gyrodactylus* sp. has infected both skin and fins of the fishes. Although both fish species belonged to the same family, the parasitic infestations on each fish species seem different. When the infected parasite species between two fish species are compared, *Posthodiplostomum cuticola* and *Chilodonella* sp. were not recorded from the koi carp, while *Argulus* sp. was not detected in Gold fish (Table 1 and 2). Metacercaria of *Centrocestus* sp. has highly infected on gills of both fish species, which encysted on the gill cartilage. According to the results, high prevalence of *Centrocestus* sp. has been recorded from gold fish than koi carp during two seasons (gold fish: wet- 80%, dry- 90%) (Koi carp: wet- 62%, dry- 64%).

However, in Thilakaratne *et al.* (2003) study between two fish species, *Centrocestus* sp. has been recorded from goldfish but not in koi carp. Wide range of host specificity of *Centrocestus* sp. has been reported from the past studies (Wimalawickrama and Pathiratna 2005; Alcaraz *et al.* 1999; Han *et al.* 2008; Mitchell *et al.* 2002).The present study revealed the prevalence of parasitic infections and their seasonal variations on two economically important ornamental fish species during two seasons at Rambadagalle fish breeding center, and the information derived could be considered important when constructing treatment plans. However, parasitism in fish occurs as a result of interactions among the parasite, the fish and the environment (Wildgoose 1998), therefore interaction of these three factors should be considered when constructing proper health management programs.

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